# HABITAT SELECTION OF FOUR AFRICAN TREEFROGS (*Leptopelis boulengeri, Hyperolius fusciventris bourtoni, H. guttulatus* and *Afrixalus dorsalis*) IN DEGRADED ENVIRONMENTS OF THE NIGER DELTA, NIGERIA

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***ABSTRACT***

***The habitat structures of four species of African treefrogs (Leptopelis boulengeri, Hyperolius fusciventris bourtoni, H. guttulatus and Afrixalus dorsalis) in two degraded environments (Kwale and Patani) in the Niger Delta were investigated. There were a total of 381 individuals collected of which H. f. bourtoni was the most abundant species (173 individuals) at all sites while the least was L. boulengeri (41 individuals). Relatively even distribution of the treefrog species were observed at both study sites, however only L. boulengeri showed a significant difference ($P < 0.05$, $df=1$, $x^2 = 5.488$) among individuals at the two study sites. More female (195) individuals were recorded than males (186). Significantly more individuals of treefrog species were observed during the rainy season than the dry season except in H. guttulatus ($P > 0.05$, $df =1$, $x^2 = 27.520$) which was not significant. L. boulengeri occurred mainly in high elevations on the leaves and branches of shrubs and trees and were mainly seen in elevations between 3.1-≥4m above the ground level. H. f. bourtoni were sighted mostly from the leaves of grasses between 0.3-0.6m. Majority of H. guttulatus occupied leaves of shrubs and trees between 0.7-1.6m and a large number of individuals were collected from the roots of Pistia stratiotes submerged under water during the dry season. A. dorsalis occupied the lowest altitude among the species studied as many individuals were found between 0.08-0.4m on the leaves of grasses above water. L. boulengeri had the highest mean SVL and weight of 5.02±0.71cm and 8.93±0.91g respectively while H. f. bourtoni had the smallest of 2.30±0.31cm and 1.11±0.14g respectively. Female specimens were generally larger than males. Degraded secondary habitats offer a variety of microhabitats which are effectively utilized by these treefrogs species thus reducing interspecific competition.***

**Key words:** African treefrogs, habitat destruction, morphology, microhabitats, competition

## INTRODUCTION

Treefrogs are group of anurans that spends a major portion of its life span on trees, shrubs and grasses, exhibiting an arboreal behaviour (Schiotz, 1999). Morphologically, they are usually smaller and more slender when compared to terrestrial frogs. They also possess well-developed discs at the toe and finger tips with slender limbs giving them greater grasping ability. Schiotz (1999) reported that treefrogs are pretty, diverse in biology and morphology, evasive and therefore exceedingly well-suited to satisfying the hunting instinct of the field naturalist.

There has been much debate on the classification of African treefrogs. For many years, the treefrogs were grouped in one family Rhacophoridae (Noble, 1931). The separate status of Hyperoliidae (e.g. *Hyperolius sp* and *Afrixalus sp*) was later adopted (Laurent, 1951; Drewes, 1984; Channing, 1989 and Blommers-Schlosser, 1993). Also Emerson *et al*., (2000) found *Leptopelis sp* to be more closely related to the family Arthroleptidae than Hyperoliidae, thereby conferring them to the former family (Frost *et al*., 2006).

The African treefrogs inhabit a diversity of habitat in Sub-Saharan Africa. West Africa being a part of Sub-Saharan Africa was described in older and recent herpetological papers as a region approximately from Senegal in the northwest, along the western coast of the continent to Gabon, or even further South to northern Angola (Rodel *et al.,* 2014).

However, recent investigations showed that the upper and parts of the lower Guinean forests, as defined based on plants distinction (Udvardy, 1975; White, 1983), comprise very unique amphibian faunas (Penner *et al.*, 2011). In West Africa generally, with particular reference to Nigeria, tree frogs are found to inhabit the dense forest, savanna and the degraded forest also termed as bushlandSchiotz (1967) termed this habitat as farm bush, where extensive areas of former forest belt have been replaced with a mosaic of fields, shrubs and immature secondary forest due to centuries of farming. The West African forests are within the 25 most important biodiversity hotspots of the world (Myers *et al.,* 2000) but they are highly threatened by logging, agriculture and increasing human populations (Bakarr *et al*., 2001). Habitat loss and degradation are by far the greatest threat of amphibians, affecting 63% of all species (Stuart *et al*., 2004).

Recent investigations (Onadeko & Rodel, 2009; Onadeko *et al*., 2010) revealed a fairly rich diversity of amphibian assemblages with a number of tree frogs species in Southwestern (Lagos, Ogun and Oyo States) and Southeastern (Cross River National Park and Obudu Plateau) Nigerian localities. Akani *et al*., (2004) revealed the diversity of amphibian species (with *Hyperolius, Afrixalus* and *Leptopelis* inclusive) in the Niger Delta and studied the effect of habitat alteration on the species due to the development of oil industry.

The Niger Delta has retained the largest mangrove formation of the entire continent as well as some patches of rainforest that are centres of endemism for many faunal and floral groups (Kingdon, 1990). However, much of the rainforests in this location have been converted into farmbush due to shifting agricultural practices. Much work has not been done on the distribution and abundance of tree frogs species in the Niger Delta especially in locations along the Niger River where forest degradation has occurred resulting into farmbush habitats. The aim of this work is to investigate the distribution and abundance of some tree frogs species in farmbush habitats which would give some insight on their niche differentiation with respect to the various positions they inhabit on vegetation and their various morphological structures.

## MATERIALS AND METHODS

### Study Area

Field studies were conducted at study sites around two towns (Kwale and Patani) situated along the Niger River in the Niger Delta region, Delta State, Nigeria (Figure 1). Two survey sites (each about 10,000m$^2$) were selected from the outskirt of each town with distances of about 500m-2km from the Niger River. The description and location of the site were briefly summarized in Table 1.

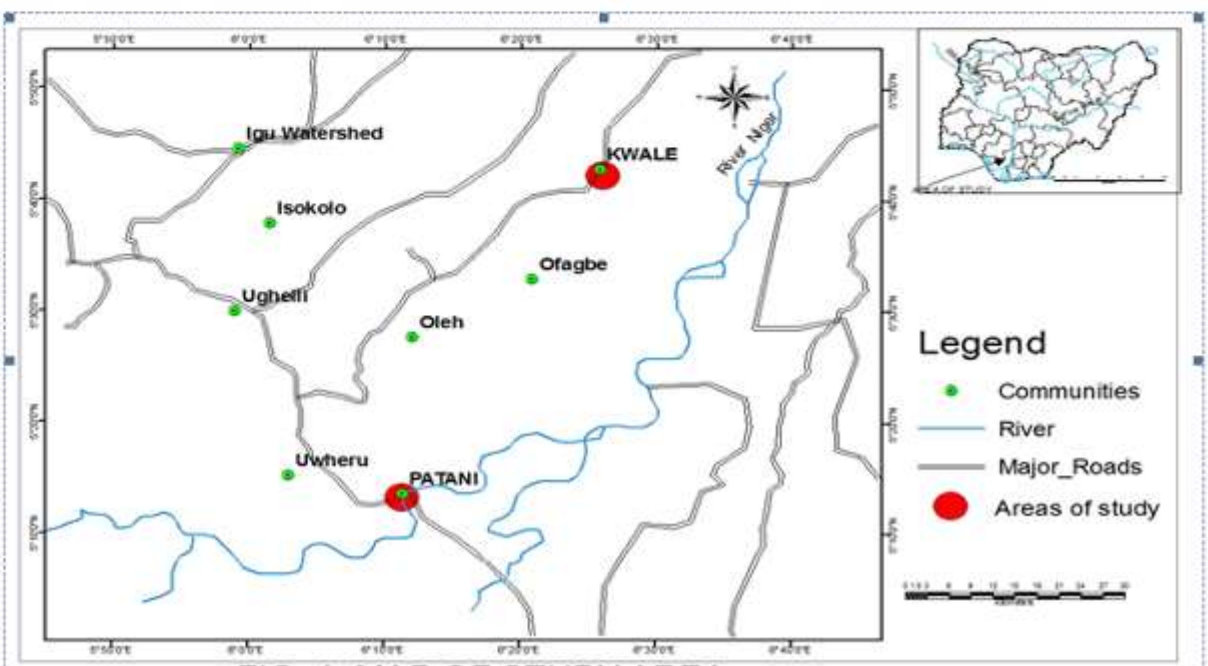


Fig. 1. The study area of Patani and Kwale sampling sites around several Niger Delta communities.

| Towns | Study Sites | Brief Habitat Description | GPS Location | |
|---|---|---|---|---|
| | | | Latitude(N) | Longitude(E) |
| Kwale | KW 1 | Secondary forest with a low canopy. Undergrowth with sparse vegetation and usually covered with temporary ponds during the rainy season | $05^{o}\ 41^{'}\ 828^{''}$ | $06^{o}\ 32^{'}\ 117^{''}$ |
| | KW 2 | Secondary and tertiary vegetation with a few ponds. Thick undergrowth located in a few areas especially close to the ponds. | $05^{o}$ 41’ $585^{''}$ | $06^{o}\ 35^{'}\ 471^{''}$ |
| Patani | PA 1 | Irregular patches of secondary forests and an abandoned farmland. A small stream flowing through | $05^{o}\ 08^{'}\ 966^{''}$ | $06^{o}\ 11^{'}\ 954^{''}$ |
| | PA 2 | Secondary forest bordering a palm plantation with a small river flowing through. | $05^{o}\ 11^{'}\ 323^{''}$ | $06^{o}\ 10^{'}\ 112^{''}$ |

Generally all the sites are located within the equatorial rainforest region of the Niger Delta ecosystem, but are concurrently characterized by few remnants of rainforest patches and majorly by degraded lands due to decades of farming and logging. However, most of the area have a few ponds during the dry season and becomes entirely flooded during the rainy season.

**Sampling Methods and Efforts**

The same method of sampling and duration of time was applied to all the study sites. The tree frogs species were located opportunistically using the VES (visual encounter survey) and the AES (acoustical encounter survey) methods (Rodel and Ernst, 2004). To standardize sampling efforts, similar duration of time and number of personnel were used in all survey sites.

The study was carried out both during the dry season (25 January-15 February 2013 in Patani; 5-18 February 2014 in Kwale) and the rainy season (10-25 July 2013 in Patani; 26 June-8 July 2014 in Kwale). A total of 40 days (five days each at each site for each season) was spent with each site having six hours [three hours each for day (07:00-10:00 hrs) and night (19:00-22:00 hrs)] of sampling periods.

**Spatial and Morphological Determination**

The search for the three genera of tree frogs covered all vegetative habitats from tree canopies to various levels of shrubs, grass cover, swamp edges and floating vegetation. The search also extended to under water surfaces, logs, stones and crevices where stick was used to probe hiding individuals. Particular habitats were noted where an anuran species was frequently observed. Treefrogs collected were marked by toe clipping which prevented recounting thereby giving a biased result.

The snout-vent-length (SVL) was measured with a digital caliper (Model no. TCMD-22290) to the nearest 0.1mm. The individuals were weighed on an electric Ohaus laboratory balance (Model no. EP 214C) and the sex determined by observing the throat region (only males possess vocal sac for calling).

**Statistical Analysis**

The Chi-square analysis was used to ascertain the difference in the number of treefrogs species investigated.

**RESULTS**

**Tree Frogs Species Observed**

The species of tree frogs studied and photographed were; *Leptopelis boulengeri, Hyperolius guttulatus, H. fusciventris bourtoni* and *Afrixalus dorsalis.* These species are shown in Plates 1 to 6.

Plate 1. *H. guttulatus* Phase J morph

Plate 2. *H. guttulatus* Phase F morph

Plate 3. *Leptopelis cf boulengeri*

Plate 5. *H. fusciventris bourtoni* Phase J

Plate 4. *Afrixalus dorsalis*

Plate 6. *H. fusciventris bourtoni* Phase F (ventral view)

**Abundance**

A total of 381 individuals of treefrogs belonging to the three genera were collected during this study. *H. fusciventris bourtoni* was the most numerous species observed (173 individuals) at all sites while the least species observed was *Leptopelis boulengeri* (41 individuals). There was a significant difference between the number of tree frogs species collected ($P < 0.05$, $df = 3$, $x^2 = 115.535$). There was a relative even distribution of the tree frog species at both Kwale and Patani study sites, however only *L. boulengeri* showed a significant difference ($P< 0.05$, $df=1$, $x^2 = 5.488$) among individuals at the two study sites. *L. boulengeri* had 28 (68.29%) of its individuals at Kwale and 13 (31.71%) at Patani (Table 2). The survey also revealed more female (195) individuals were recorded than males (186) out of the total number of individuals (381). Higher female individuals were observed in *H. fusciventris bourtoni* and *H. guttulatus* while more males were observed in *A. dorsalis* and *L. boulengeri*.

Table 2. The demographic structure of the treefrogs in both sampling sites.

| **Anuran species** | **Location** | | **Female (%)** | **Male (%)** | **Total (%)** |
|---|---|---|---|---|---|
| | **Kwale (%)** | **Patani (%)** | | | |
| *Leptopelis boulengeri* | 28 (15.21) | 13 (6.60) | 13 (31.71) | 28 (68.29) | 41 (10.76) |
| *Hyperolius fusciventris bourtoni* | 75 (40.76) | 98 (49.75) | 87 (50.29) | 86 (49.71) | 173 (45.4) |
| *Hyperolius guttulatus* | 61 (33.15) | 52 (26.40) | 72 (63.72) | 41 (36.28) | 113 (29.66) |
| *Afrixalus dorsalis* | 20 (10.87) | 34 (17.26) | 23 (42.59) | 31 (57.41) | 54 (14.17) |
| Total | 184 (48.29) | 197 (51.71) | 195 (51.18) | 186 (48.82) | 381 (100) |

Generally there were more individuals of tree frog species observed during the rainy season than the dry season. A total of 134 individuals were observed during the dry season while 247 individuals were observed during the rainy season. At three sites (Kwale - KW 1 & KW 2 and Patani – PA 2) there were over 50% increases of individuals belonging to *H. f. bourtoni* during the rainy season. Other anuran species except *H. guttulatus* also showed increased of individuals during the rainy season. There were however not a significant difference between the total number of individuals collected during the dry and rainy season for *H. guttulatus* ($P > 0.05$, df =1, $x^2 = 27.520$). There were more individuals of *H. guttulatus* observed at two sites (KW 2 and PA 1) during the dry season (Figures 2 and 3). This was the only species that had more individuals observed at these two sites during the dry season when compared to other anuran species at the various sites.

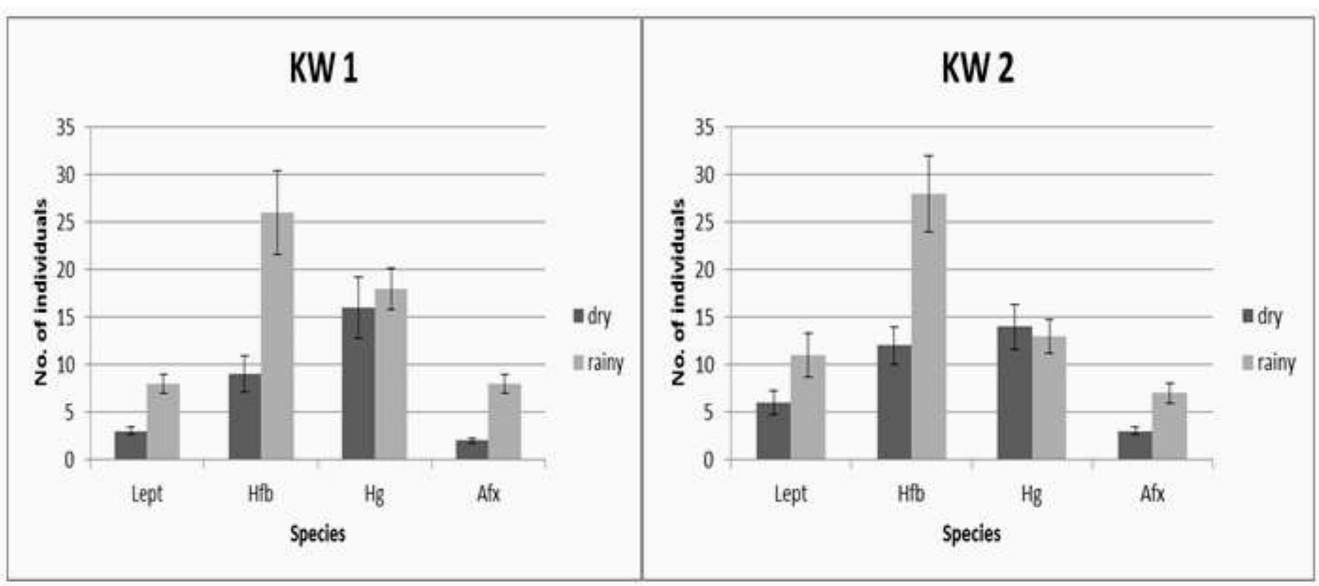


Fig. 2. Total number of individuals observed at Kwale sites (KW 1 & KW 2) after five days of sampling.

Where, Lept = *Leptopelis boulengeri*
Hfb = *Hyprolius fusciventris bourtoni*
Hg = *Hyperolius guttulatus*
Afx = *Afrixalus dorsalis*

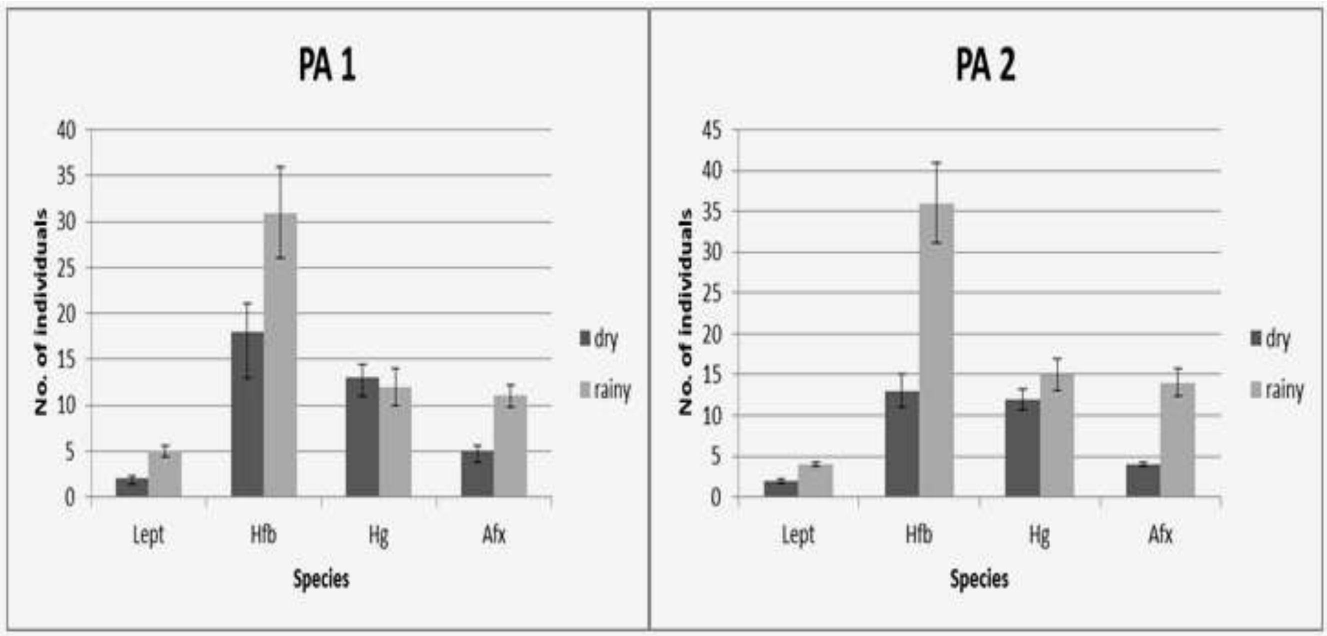


Fig. 3. Total number of individuals observed at Patani sites (PA 1 & PA 2) after five days of sampling.

Where, Lept = *Leptopelis boulengeri*
Hfb = *Hyprolius fusciventris bourtoni*
Hg = *Hyperolius guttulatus*
Afx = *Afrixalus dorsalis*

**Spatial Distribution of the Frog Species**

The tree frog species were observed to occur in various habitats. *L. boulengeri* occurred mainly in high elevations on the leaves and branches of shrubs and trees. They were mainly seen in elevations between 3.1-≥4m above the ground level (Table 3). *H. f. bourtoni* were observed mostly on the leaves of grasses between 0.3-0.6m often using their calls to sight them. Few members were also seen in higher elevation on leaves of shrubs and trees.

Majority of *H. guttulatus* occupied leaves of shrubs and trees between 0.7 to 1.6m above the ground. Also a large number of individuals were collected from the roots of *Pistia sp* submerged under water during the dry season (Plate 7). The species occupying the lowest altitude was *A. dorsalis,* as many individuals were found between 0.08-0.4m on the leaves of grasses above water. Some also inhabited the roots of *Pistia sp* during the dry season. A general description of the spatial distribution is shown in Plate 8.

| Species | Total | Vegetation type and height in metres | | | Substrate | | | |
|---|---|---|---|---|---|---|---|---|
| | | Leaf of grass | Leaf of shrub/tree | Branch of shrub/tree | Root | Leaf litter | Soil | Water |
| *Leptopelis boulengeri* | 41 | 2 (0.2-0.7) | 11 (1.5-3) | 13 (3.1≥4) | 3 | 6 | 4 | 2 |
| *Hyperolius fusciventris bourtoni* | 173 | 134 (0.3-0.6) | 28 (1.1-2.5) | 7 (2.6-3.2) | 0 | 3 | 3 | 1 |
| *Hyperolius guttulatus* | 113 | 19 (0.1-0.3) | 53 (0.7-1.6) | 3 (2-3) | 4 | 2 | 6 | 26 |
| *Afrixalus dorsalis* | 54 | 33 (0.08-0.4) | 6 (0.7-0.9) | 1 (1.2) | 1 | 2 | 5 | 6 |

Table 3. Distribution of tree frogs species in habitat studied.

(x) Figures in parenthesis represent measurement in metres above ground level.

Plate 7. The weed,( *Pistia sp*) where tree frogs specimens were collected within and between the submerged leaves and roots.

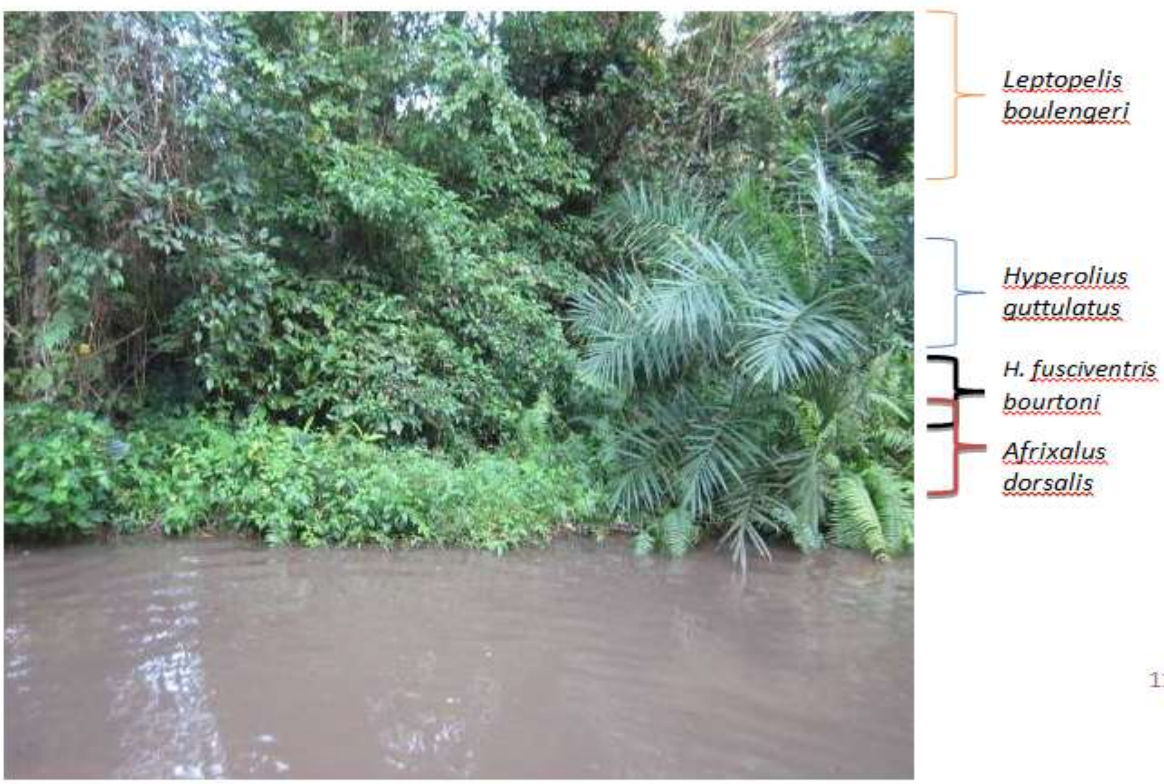


Plate 8. A typical habitat beside a temporary pool where tree frog species are distributed. The various species would normally occur in the altitudes of the areas indicated. Note: Species may occur in other areas in which they are not normally observed.

**Morphometry**

Among the tree frog species examined, *L. boulengeri* had the highest mean SVL and weight recorded which were 5.02 ± 0.71cm and 8.93 ± 0.91g respectively. This was followed by *H. guttulatus* whose mean SVL and weight were 3.31 ± 0.19cm and 3.32 ± 0.46g respectively. *H. fusciventris bourtoni* had the smallest mean SVL and weight which were 2.30 ± 0.31cm and 1.11 ± 0.14g respectively (Table 4). Overall, female specimens generally had a larger morphology than males with respect to the measured mean SVL and weight.

Table 4. Morphometric characteristics of tree frog species.

| **Species** | **SVL (cm)** | **Weight (g)** |
|---|---|---|
| *Leptopelis boulengeri* | 5.02 ± 0.71 | 8.93 ± 0.91 |
| | F (4.86-5.96) | F (8.82-10.16) |
| | M (4.02-5.03) | M (7.61-9.01) |
| *Hyperolius fusciventris bourtoni* | 2.30 ± 0.31 | 1.11 ± 0.14 |
| | F (2.21-2.86) | F (0.91-1.27) |
| | M (1.95-2.53) | M (0.84-1.22) |
| *Hyperolius guttulatus* | 3.31 ± 0.19 | 3.32 ± 0.46 |
| | F (3.11-3.71) | F (2.91-3.97) |
| | M (2.98-3.49) | M (2.66-3.60) |
| *Afrixalus dorsalis* | 2.51 ± 0.56 | 1.36 ± 0.34 |
| | F (2.40-2.97) | F (1.28-1.62) |
| | M (2.29-2.81) | M (1.16-1.55) |

F= females M= males

**DISCUSSION**

The findings from this study indicated that the difference of the tree frogs caught between the dry and rainy seasons, was significant as over 50% of the individuals of most frog species were absent during the dry season. The rainy season creates a more conducive habitat for the frogs to thrive. The findings in this research are in conformity with data collections on seasonal phenology of Nigerian frogs, demonstrating that frog activity peaks during the rainy season (Akani *et al,* 2004; Onadeko *et al*, 2013). Other researchers have also observed a peak in anuran abundance during the wet season (Duellman, 1995; Vonesh, 2001) which is also related to their phenology of reproductive activity. However the difference of frogs caught during the dry and rainy seasons was not significant compared to other ecosystems in Nigeria studied such as the savanna, deciduous forest and derived savanna (Onadeko *et al*, 2013) as anuran species present in these locations had at times, all of their members absent during the dry season. This is because the Delta region along the Niger River is composed of many tributaries coupled with many swamps, so even during the dry season there is availability of water existing from swamps and many permanent pools left from drying streams (Onadeko *et al,* in press). This condition favours the thriving condition of amphibians also during this time of the year.

There was higher number of *H. guttulatus* collected during the dry season at some sites. These *H. guttulatus,* were found mainly gathered under roots of *P. stratiotes* which were partly submerged, along with a few other treefrog species especially *Afrixalus dorsalis*. They probably inhabited these locations to avoid unfavourable conditions of the dry season or to carry out reproductive purposes.

Generally there were more specimens of the tree frogs collected at Patani than Kwale sites though not significant. This may be attributed to the fact that there were more aquatic habitats (e.g. temporary and permanent pools) with vegetation located at the sites of Patani. These environments were ideal for the living conditions of mostly *H. f. bourtoni.* However, over 50% of *L. boulengeri* were collected at Kwale compared to Patani. Patani is over 50 km south of Kwale which is closer to the Niger Delta mangrove ecosystem. This ecosystem may not be very suitable for the optimal thriving conditions of the *Leptopelis sp*, hence its reduced population. Kwale which is further north is situated mainly in degraded and primary forest ecosystems and these may be more suitable for the survival of these species. Further studies may be required to justify this.

The total number of female specimens collected was more than the males though not significant as well. There were however over 60% of females and males collected for *H. guttulatus* and *L. boulengeri* respectively.

This may be due to chance collection and not necessarily due to aggregation of the same sex in the study location. Also morphologically, the female specimens were larger in all the tree frogs species studied and hence may reflect in the relative ease of catch. Similar observations were made by Luiselli *et al.*, (2004) on *H. guttulatus*, *H. concolor* and *H. sylvaticus*. There was statistically significant sexual size dimorphism observed in these species except in *H. fusciventris.*

It was observed that the tree frog species exhibited partial niche differentiation by spatial partitioning. *L. boulengeri* being morphologically differentiated by having the largest size and weight inhabited the highest altitudes in the various sites studied. They inhabited mainly the leaves and branches of large shrubs and trees that could carry their weight. Few individuals were also observed on leaf litter and on the soil during the dry season and at times after heavy down pour of rain. Foraging and reproduction activities may be responsible for these circumstances respectively. Unlike the *Leptopelis sp., H. f. bourtoni* and *A. dorsalis* with smaller weights mainly inhabited the leaves of grasses at lower altitudes of the environment. *H. f. bourtoni* were found majorly located around smaller bodies such as temporary pools. They inhibited vegetation located above or at the side of the pools. Some species were also observed at higher altitudes in the environment. This finding agrees with those of Kouame *et al.*, (2014) who investigated the variability, call characteristics and habitat of *Hyperolius laurenti.* They observed that this tree frog species predominantly occupied small trees and shrubs 2-3 metres above the ground. *A. dorsalis* were majorly found around larger and more permanent pools. They sat on leaves of vegetation having its outgrowth with in the pool. This may imply that they are more drought sensitive and therefore must seek out moist places.

*H. guttulatus* with a slightly greater size than *H. f. bourtoni* and *A. dorsalis* also inhabited mainly leaves and branches of shrubs. They were found in slightly higher altitudes than *H. f. bourtoni* and *A. dorsalis.* But however during the dry season, they were present mostly submerged among the roots of *P. stratiotes* along with few individuals of *A. dorsalis* but rarely with *H. f. bourtoni* and *L. boulengeri.*

Ernst and Rodel, (2006) observed that though some species seem to respond to particular habitat parameters and thus show different habitat preferences, limitation to these habitats are difficult to quantify and may change throughout the season, with potentially higher impacts within secondary forest habitats. This phenomenom was observed in this study with the tree frog species inhabiting different altitudes with in the vegetative structures and with some species especially *H. guttulatus* inhabiting the submerged roots of *Pistia sp* mainly during the dry season. Also Ernst and Rodel, (2005) revealed that the relatively high structural heterogeneity of the environment is likely to produce a great amount of habitats that can be used by different species and therefore may prevent species from competing. This confers survival ability to treefrog species as may be the case in the studied areas for this study. Numerous microhabitats formed in these degraded environments, reduces the competition that would likely be faced by these species in homogenous environment. It is probable that species of different sizes occupy different microhabitat, thereby leading to difference in food and feeding habits which reduce competition. Luiselli *et al.,* (2004) studied the feeding relationship of four tree frogs and found out that Araneidae and Blattoidea were preyed upon by the two largest species while Acarina and Lepidoptera were taken mainly by the two smaller species of tree frogs. Partitioning of spatial resources of poikilothermic terrestrial vertebrates has been demonstrated to be a crucial structuring element for the communities of some taxonomic groups as reported by (Pianka, 1986; Luiselli, 2006a & Luiselli, 2006b).

In conclusion it can be inferred that, degraded secondary habitats offer a variety of microhabitats which are effectively utilized by these tree frogs species thus reducing interspecific competition. These environmental attributes offer greater spatial resources both in terms of habitat and food security in which greater separation is observed among these species during the rainy season. However during the dry season when precipitation drops coupled with low humidity leading to decrease in availability of aquatic habitats, there is greater congregation of these species in conducive habitats which may lead to competition (for example various species are found submerged under the roots of *Pistia sp*). There was an overlap of habitat and resource acquisition among the tree frogs during the seasons, but the diversity of microhabitats has minimized overall level of competition.

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## APPENDIX I

Difference in total number of different tree frog species (the first hypothesis on table two)

| | Variable | Observed N | Expected N | Residual | $X^2$ | df | P |
|---|---|---|---|---|---|---|---|
| Tree frogs | *L. boulengeri* | 41 | 95.3 | -54.3 | 115.535 | 3 | 0.000 |
| | *H. f. bourtoni* | 173 | 95.3 | 77.8 | | | |
| | *H. guttulatus* | 113 | 95.3 | 17.8 | | | |
| | *A.dorsalis* | 54 | 95.3 | -41.3 | | | |
| | Total | 381 | | | | | |

**APPENDIX II**
Individual species and locations (third hypothesis on second table)

| | Variable | Observed N | Expected N | Residual | $X^2$ | df | P |
|---|---|---|---|---|---|---|---|
| | Kwale | 28 | 20.5 | 7.5 | | | |
| *L. boulengeri* | Patani | 13 | 20.5 | -7.5 | 5.488 | 1 | 0.019 |
| | Total | 41 | | | | | |
| | Kwale | 75 | 86.5 | -11.5 | | | |
| *H. f. bourtoni* | Patani | 98 | 86.6 | 11.5 | 3.058 | 1 | 0.080 |
| | Total | 173 | | | | | |
| | Kwale | 61 | 56.5 | 4.5 | | | |
| *H. guttulatus* | Patani | 52 | 56.5 | -4.5 | 0.717 | 1 | 0.397 |
| | Total | 113 | | | | | |
| | Kwale | 20 | 27 | -7 | | | |
| *A.dorsalis* | Patani | 34 | 27 | 7 | 3.630 | 1 | 0.057 |
| | Total | 54 | | | | | |

**APPENDIX III**
Different tree frogs species and Seasons

| | Variable | Observed N | Expected N | Residual | $X^2$ | df | P |
|---|---|---|---|---|---|---|---|
| | Dry | 13 | 20.5 | -7.5 | | | |
| L. boulengeri | Wet | 28 | 20.5 | 7.5 | 5.488 | 1 | 0.019 |
| | Total | 41 | | | | | |
| | Dry | 52 | 86.5 | -34.5 | | | |
| H. f. bourtoni | Wet | 121 | 86.6 | 34.5 | 27.520 | 1 | 0.000 |
| | Total | 173 | | | | | |
| | Dry | 55 | 56.5 | -1.5 | | | |
| H. guttulatus | Wet | 58 | 56.5 | 1.5 | 0.080 | 1 | 0.778 |
| | Total | 113 | | | | | |
| | Dry | 14 | 27 | -13 | | | |
| A. dorsalis | Wet | 40 | 27 | 13 | 12.519 | 1 | 0.000 |
| | Total | 54 | | | | | |